

# Alone or Together? Inter-Organizational Affiliations of Open Source Communities

## Abstract

Many of today's open source software (OSS) communities operate beneath an umbrella organization, while others are organized entirely independently, and yet others follow a strategy somewhere in between, sharing certain resources and services. In our paper, we analyze four mature OSS communities (GENIVI, PolarSys, LibreOffice and PostgreSQL) representing different organizational forms. Our qualitative case studies illustrate that OSS communities preferring to control all of their resources are organized autonomously, while those focused mainly on software development are integrated into an umbrella organization. An interjacent strategy is pursued by OSS communities affiliated with an intermediary form of organization that takes care of legal and financial issues, without prescribing organizational structures or a specific license. The findings of our case studies show that there is no one-size-fits-all approach for OSS communities and each strategy has specific advantages and disadvantages. Arguing with the theoretical concepts of Resource Dependence Theory (RDT) and Transaction Cost Economics (TCE), we are able to relate the findings of our qualitative empirical study to theoretical concepts explaining different organizational behavior. Therefore, this study contributes new insights concerning the inter-organizational affiliations of OSS communities thus responding to the question why different forms of OSS community governance exist.

**Keywords:** Open Source Software, Collaborative Software Development, OSS Governance, OSS Foundations.

## 1. Introduction

The development of software according to the principles of Open Source Software (OSS) represents a frequently used alternative to developing proprietary software. Following the open source route has several consequences and peculiarities regarding organizational characteristics. The structural evolution of an OSS community is described by de Laat (2007) as a three-phase model. In phase one, governance is spontaneous and explicit coordination and control are non-existent. In phase two, internal governance with formal tools is introduced, e.g. division of roles, training, modularization or decision-making. This enables an OSS community to be governed internally in order to increase efficiency and effectiveness as the community grows. Eventually, in phase three, if the OSS community is successful and companies or other organizations want to participate, such an involvement of outside parties needs to be institutionalized. In this final stage, a legal entity like a non-profit foundation is established in order to protect developers, the OSS community itself, and to enhance collaboration (Riehle, 2010; Riehle and Berschneider, 2012).

As an OSS community matures, its leaders have to decide whether to continue the community as it is, to create their own foundation or to join an existing foundation (Riehle and Berschneider, 2012). The benefits of OSS foundations for their communities are manifold (Riehle, 2010). One frequently cited argument for a foundation is that it can act as a legal representative of the community. It can defend its interests in court and protect members from individual liability (O'Mahony and Bechky, 2008; Riehle, 2010; Riehle and Berschneider, 2012). A foundation also increases a community's credibility and makes it less dependent on specific individuals and organizations (Riehle and Berschneider, 2012). In addition, OSS foundations provide a wide range of services to their communities. Eckert (2017) gives a list of OSS foundations and the various services they offer.

While many mature OSS communities are part of a foundation because of the services they provide (Eckert, 2017), studies are needed contributing to an explanation of why some OSS communities are part of an umbrella organization while others choose to remain entirely independent. OSS communities have to decide on their governance structure in order to satisfy the expectations of today's OSS developer and user community. Professional software users require more than just the code of an OSS project: they need compliance with software licenses, legal assurances that there are no Intellectual Property Rights (IPR) infringements, knowledge-sharing events, reputational visibility of the software they are using and more. While there are good arguments in favor of joining a foundation, some mature OSS communities remain completely independent. Various characteristics of OSS foundations have already been examined (Riehle and Berschneider, 2012). However, so far no in-depth comparison regarding the advantages and disadvantages of the inter-organizational affiliations of OSS communities has been developed. Why do such different forms of mature OSS communities exist? Is it possible to derive an explanation of the different configurations by a theory-based approach?

Our article attempts to fill this gap by answering the following two research questions:

*RQ1: What are the different forms of inter-organizational affiliations of OSS communities?*

*RQ2: What are the arguments for and against the different forms of inter-organizational affiliations of OSS communities?*

The remainder of this paper is structured as follows: Section 2 provides an overview of related literature on OSS foundations, as well as research on organizational theories, specifically two economic management theories: Resource Dependence Theory (RDT) and Transaction Cost Economics (TCE). In Section 3 we explain our research method, and in Section 4 our case studies and their main findings are presented. The results of the case studies, their limitations and impact as well as suggestions for future research are discussed in Section 5.

## **2. Literature**

In order to better understand the context of our research questions, the following section introduces previous research on OSS foundations and relevant theories helping to clarify theoretical explanations of organizational strategies.

### **2.1 Research on OSS Foundations**

As the literature review by Manikas and Hansen (2013) points out, research on software ecosystems began in 2010. In an update Manikas (2016) identifies business and management issues as important aspects. Both reviews highlight the need for governance of a software ecosystem. OSS foundations support the development of such governance for a single community as well as for several communities simultaneously.

One of the reasons for the existence of OSS foundations is their provision of legal protection for OSS communities and their contributors. O'Mahony (2003) has identified seven primary tactics by which OSS communities can guard their work against proprietary appropriation and protect their collective identity and reputation. Those tactics include licenses, individual liability, the holding of assets, trademarks and brands. All seven tactics are best established by a foundation. The first legal institutions to represent and protect technical communities have started already in the late 70's and

80's (O'Mahony, 2005). The earliest specifically OSS related legal association was "Software in the Public Interest" (SPI), founded in 1997.

In addition to legal protection, OSS foundations may also provide financial benefits. Riehle (2010) shows financial reasons behind software firms joining or supporting OSS foundations. Some members expect cost savings for products built on the OSS platform, others expect increased revenues from complementary products, while some support OSS foundations in order to increase their target market. Moreover, Riehle demonstrates that the responsibilities of an OSS foundation may go beyond financial and legal considerations: the foundation may also be responsible for establishing a strategy for the software, organizing the community and advertising the software.

The activities of such OSS foundations are diverse. According to Markus (2007), governance of OSS communities can be grouped into six categories of formal and informal structures and rules: ownership of assets; chartering of the community; community management; software development process; conflict resolution and rule changing; and use of information and tools. All six structures and rules can be part of an OSS foundation, bundling the collaborative effort of one or more OSS communities. In addition, the nature of OSS foundations is dynamic. Currie, Kelty and Murillo (2013) have described that OSS communities follow trajectories from informal "Organized Publics" towards "Formal Social Enterprises" (e.g. in the case of Linux) and in the opposite direction (e.g. in the case of OpenOffice).

In recent years, a number of OSS foundations has allowed existing OSS communities to join so they could benefit from the foundation's range of services such as their legal entity and potential cost savings (Eckert, 2017). For example, since 2008, the Linux Foundation has provided services as umbrella organization in order to govern collaborative OSS communities. Such services include the provision of IT-infrastructure and a legal framework, as well as sharing expertise in the OSS environment (The Linux Foundation, 2017). Another organization offering similar services to industry-specific OSS communities is the Eclipse Foundation. Its integrated communities, so-called 'working groups', benefit from governance and development practices, IPR-management, IT-infrastructure, and marketing channels. The Eclipse Foundation's first working group, PolarSys, is one of the OSS communities included in our study.

Eckert (2017) presents an organizational framework allowing the comparison between OSS communities and organizations. According to this framework, the services provided by a foundation to its integrated communities are structured in the three main categories of people, organization and assets. A recent study by Lindman and Hammouda (2018) found additional support mechanisms by governance entities. In particular, they describe the important role of the support entity during the incubation process of a new portfolio project. Such an incubation phase is useful for the members of the community to learn the foundation's norms and processes.

Riehle and Berschneider (2012) have introduced a model of OSS developer foundations based on six categories: general, philosophy, intellectual property (IP), governance, financing and operations. These categories provide attributes allowing OSS community leaders to compare existing foundations with their needs or to design their own foundation. The model was applied to nine foundations and presents an overview comparing existing foundations and showing the structures and properties of OSS foundations. Moreover, the model can be used to design such a foundation.

Previous research on OSS foundations has focused on the reasons for their existence and the benefits communities get from them. However, as Riehle and Berschneider (2012) point out, joining an existing foundation is only one alternative. OSS communities wishing to incorporate as a legal entity can also set up their own foundation. So far it is not clear how OSS communities decide which option to take and why different configurations exist. Since these questions have not yet been

addressed thoroughly in previous research on OSS we have looked into related research on organizational governance.

## 2.2. Research on Organizational Theories

There are numerous theories explaining collaboration and control among organizations (Gray and Wood, 1991; Rossignoli and Ricciardi, 2015). To identify possibly relevant approaches, we have examined the literature on non-profit organizations (NPOs) and their reasons for collaboration with other legal entities. We decided to look at NPOs because we perceive some similarities between the organization of OSS communities and NPOs. Most notably, both are not profit- but interest-driven and rely strongly on voluntary service. Research on NPO collaboration emphasizes the importance of the Resource Dependence Theory (RDT) and Transaction Cost Economics (TCE) as the main explanatory approach for the collaboration of different legal entities. These theories point out the usefulness of a partnership to increase organizational resources or to reduce the need to compete for resources (Gazley and Brudney, 2007; Grønbjerg, 1993; Guo and Acar, 2005; Pfeffer and Salancik, 1978; Saidel, 1994). In the following subsections, we therefore sum up research on RDT and TCE.

### 2.2.1 Resource Dependence Theory

RDT argues that organizations depend on resources originating not from within themselves but from their environment. The resources required by one organization may be in the hand of other organizations. Consequently, formally independent organizations can nevertheless depend on one another because of their possession of, or need for, certain resources. From this perspective, resources represent a source of power. Organization A's power over organization B is equal to organization B's dependence on organization A's resources (Pfeffer and Salancik, 1978). This dependence of an organization reflects an uncertainty regarding resources.

In response to this uncertainty in their resource environment, RDT suggests that organizations should collaborate to secure critical resources. Collaboration facilitates the acquisition of critical resources and, consequently, reduces uncertainty (Pfeffer and Salancik, 1978). However, such collaboration is not without cost. The greatest expense of developing collaborative activities is arguably the loss of operating autonomy (Provan, 1984). Formal types of collaboration allow better control of critical resources, yet these relationships are almost always accompanied by a greater loss of autonomy and thus involve relatively higher costs in terms of managerial autonomy (Zuckerman and D'Aunno, 1990). Nevertheless, organizations are often willing to surrender a degree of autonomy in exchange for a better chance at resource sufficiency.

A key challenge for any organization choosing among different forms of collaboration is retaining the dynamic balance between managing resource dependence and sustaining organizational autonomy. Recognizing the necessity of inter-organizational relationships to acquire resources, the focus is on minimizing inter-organizational dependencies while preserving the autonomy of the organization (Gray and Wood, 1991). Murray (1998) has argued that the degree of interdependence between the parties is key to understanding the difference in forms of collaboration: at one end of the continuum in interdependence is the simple one-time transaction, in which one organization exchanges something with the other; at the other end is the full legal merger of the two organizations. In order of decreasing autonomy and increasing formality interdependence ranges from collaboration, through alliances to integration, parent subsidiary, joint venture, and merger. One of the most common ways to gain control is by acquiring all relevant resources and merging them into one single organization (Casciaro and Piskorski, 2005; Hillman et al., 2009).

These theoretical insights may be transferred to OSS communities. By its very nature, an OSS community is a permeable, constantly altering organization with little control over its key resources,

such as the developer community or project funding (O'Mahony and Bechky, 2008; Alexy et al., 2013). Existing foundations already have a community with various roles and tasks. Independent communities may therefore hope to grow and gain access to new skills and sources of capital by joining an OSS foundation. Moreover, the increased visibility or legitimacy could lead to more donations. On the other hand, by joining an existing foundation OSS communities surrender some of their autonomy.

Concerning the control of resources within OSS communities, the role of software firms is relevant. Within the Eclipse environment Schaarschmidt, Walsh and Kortzfleisch (2015) found that firms are able to influence OSS development by two resource-based options: Either by exerting control through leadership (e.g. hiring existing community leaders) or by deploying resources to the project (e.g. assigning more firm-sponsored committers). These examples illustrate the importance of resource-based control within OSS communities.

## **2.2.2 Transaction Cost Economics**

TCE focuses on transactions between market partners and the cost associated with these transactions. From the perspective of an organization, the acquisition of a particular commodity may be from its own resources (hierarchy) or from external suppliers (market). The decision as to which of the two options is most advantageous depends on the transaction cost associated with both of these options. Consequently, different organizational structures may result (Williamson, 1975). There are three critical dimensions characterizing transactions: the frequency of transactions, the degree to which long-lasting transaction-specific investments are incurred, and uncertainty related to the transactions (Williamson, 1979).

Frequency is important because the cost of a specialized hierarchy will be easier to recover for transactions of a recurrent nature. More frequent transactions thus tend to be organized within the hierarchy (Williamson, 1984). In the context of OSS this may be illustrated by companies donating money in order to create or maintain a relationship with an OSS community (Dahlander and Magnusson, 2005). Also individuals who use OSS donate money to support the community. As a result, many communities offer the option of donations. The processes involved with donations, such as bookkeeping and issuing tax exemption statements for donors, occur frequently. Those processes are highly standardized per country, occur often and do not require transaction-specific knowledge. In general, legal changes applicable to bookkeeping and the issuing of tax exemption statements do not occur very often and uncertainty is rather low. Therefore, donation management and bookkeeping are typical services that may be outsourced to OSS foundations.

Transaction-specific investments are seen as the most important of the three critical dimensions. If investments are specific to particular transactions, they are lost when those transactions cease to be relevant (Williamson, 1981). Therefore, transactions related to highly specific investments tend to be organized in hierarchy. For example, engineers and lawyers possess valuable skills; however, unless these skills are deepened and tailored to a particular employer, neither employee nor employer have a specific interest in maintaining a continuing employment relationship, because the employer can hire a substitute without losing human-asset-specific knowledge. Firm-specific knowledge, in contrast, may be highly specific and, therefore, non-transferable. In this case, the employment relationship is a source of added value (Williamson, 1981).

Uncertainty is related either to environmental uncertainty or behavioral uncertainty (e.g. opportunistic behavior) and their impact on transactions. The incentive to shift transactions from markets to hierarchy increases as uncertainty grows because the cost of harmonization varies directly with the need to adjust to changing circumstances (Williamson, 1981).

### 3. Method

For this paper we have used an exploratory case study approach to answer the research questions. As Eisenhardt (1989) and Yin (2003) have shown, case studies facilitate an in-depth view of certain situations, allowing the identification of causal relationships and underlying motivations. Moreover, exploratory research strives to find out what is happening, seeking new insights and generating ideas and hypotheses for new research (Runeson and Höst, 2009).

To analyze the case studies we have adopted a grounded theory approach because it is well suited for emergent or poorly understood phenomena. This method provides the broadest possible contextual information to understand a phenomenon lacking a theory (Corbin and Strauss, 2014), thus allowing us to identify the different motivations behind decisions of OSS communities.

Recently, grounded theory has been applied particularly in software engineering research in order to explore the human and social aspects in such technical context (Hoda et al., 2012). In their review of almost 100 grounded theory studies in software engineering Stol, Ralph and Fitzgerald (2016) found a strong increase of this methodological approach since 2005. They also identified different strands of grounded theory. In this study we follow the classic approach by Barney G. Glaser (1992), starting with open coding of the case study interviews and later conducting an extensive literature review leading to the existing RDT and TCE theories described above.

#### 3.1 Case Selection

In grounded theory, sampling serves theory construction and not representativeness (Corbin and Strauss, 2014). Unlike random sampling, we have chosen the approach of maximum variation of cases; therefore, the analyzed OSS communities display distinct characteristics and processes (Flyvbjerg, 2006). All of the studied communities have evolved in a highly competitive business-driven environment but have adopted different organizational strategies.

We chose to analyze two communities from the vertical software area where software is specific to one particular branch of industry: GENIVI and PolarSys. The GENIVI Alliance is an autonomous OSS community without any association to a higher-level OSS organization, whereas PolarSys is integrated into the Eclipse Foundation. In addition, we also chose to analyze two communities active in the horizontal software market where the same software is used across different industries: LibreOffice and PostgreSQL. Both communities are associated with Software in the Public Interest (SPI). SPI is a NPO founded to help organizations develop and distribute open hardware and software (O'Mahony, 2005). Its mission is to help free and open source software communities by handling their non-technical administrative tasks relieving them from the burden of operating their own legal entities.

#### 3.2 Data Collection and Analysis

Multiple sources of data are critical to grounded theory as they enable triangulation and validation of theoretical constructs. Therefore, the four case studies are mainly based on two different data sources: semi-structured interviews with key representatives of the OSS communities (Appendix 1) and publicly accessible governance documents (Appendix 2). In order to better describe the case studies, some scientific literature has been analyzed as well.

We have conducted 16 interviews with 14 different stakeholders (two representatives were interviewed twice to deepen the insight) following a list of questions related to our research focus (Appendix 3). All interviews were transcribed verbatim and analyzed using MAXQDA, a Computer

Assisted Qualitative Data Analysis Software (CAQDAS), to conceptualize the interview transcripts (Bringer et al., 2006). In addition, we analyzed publicly accessible legal and organizational documents from GENIVI, PolarSys, LibreOffice, PostgreSQL, SPI and the Eclipse Foundation to verify statements in the interviews and identify new aspects relating to IPR protection, community organization, members' rights, and financial aspects.

Using MAXQDA, we have identified a number of different topics with various attributes. In order to capture meanings and intentions in our data, we first made an initial coding in an open fashion. The process of open coding begins with a line-by-line analysis to identify substantive codes emergent within the data. Line-by-line coding forced us to verify and saturate codes, minimising the chance of missing an important code and ensuring that nothing had been left out (Glaser and Holton, 2007). We then examined the data again in order to find other text passages that fell within the code. In this way, we were able to identify basic ideas and concepts. After the initial coding, we discussed and compared the identified concepts. Where codes were close to each other, we determined their adequacy for larger segments or refined them as necessary. As an example, we refined the code "cost" by splitting it into different kinds of cost. We then built categories of codes structuring similar concepts – in our case, the advantage or disadvantage of a decision, such as high initial cost or costly overheads. Following on from this, we tried to establish how the different categories fit into a coherent picture. This is presented in the following section.

## 4. Case Studies and Main Findings

The following sections summarize our findings. Each case is introduced by a short history of the community and its challenges, the decision regarding inter-organizational affiliation in order to solve problems and reasons for this decision. Quotes from the interviewees are identified with the person's number (see Appendix 1). At the end of the paragraphs, the core argument is formulated in parentheses. The analysis of the resulting advantages and disadvantages of the respective choice of affiliation is presented in the final section of this chapter.

In order to illustrate the types of affiliation and relationship between the organizations and their OSS projects, Figure 1 provides an overview of the four communities and shows the three approaches. The term "Legal entity" defines a legally independent organization, "OSS community" refers to the social entity of contributors (humans), and "OSS project" concerns the technical entity (source code). Since PostgreSQL in fact has multiple legal entities, Figure 1 represents a simplification in this regard.

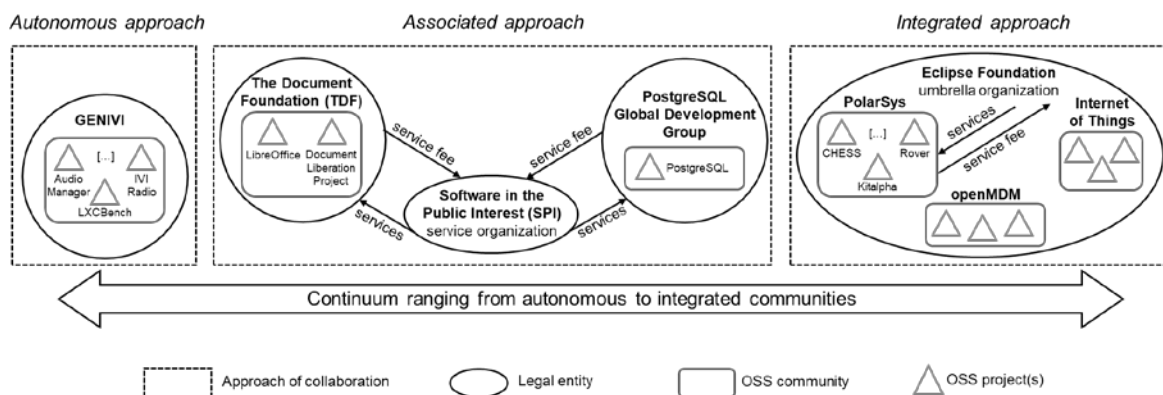


Figure 1: Varying inter-organizational affiliation of the four communities studied.

## 4.1 The Case of GENIVI

Increasing customer demand, driven especially by the rapidity of changes in consumer electronic devices such as smartphones, has led to increased functionality of vehicle software stacks. In response, specialized suppliers developed automotive software, e.g. an In-Vehicle Infotainment (IVI) system. Although functional needs did not vary much between different automotive manufacturers, they became dependent on particular vendors of software development because of long-term contracts. *“Up to that point, they were dependent on vendors [...] as their suppliers. They wanted to be able to bring the box that they purchased from their [suppliers] and be able to distribute the development of that box to multiple partners and create more competition in this market”* (P14). Due to their common needs, the market players expected to be able to develop commodity software and bring it to market as quickly and cheaply as possible without dependence on a single vendor. By sharing development cost and releasing the software produced under an OSS license, automotive manufacturers would reduce their dependence on one specific software provider. However, the different automotive manufacturers as well as software and hardware providers had to make a decision on how to organize this collaboration.

**Decision:** In 2009, BMW together with eight other founding members comprising automotive manufacturers, suppliers and software, middleware and hardware providers established GENIVI, a new non-profit corporation. GENIVI's first goal was to advance software development in the automotive industry via the use of a dynamic reusable In-Vehicle Infotainment (IVI) OSS development platform. The GENIVI Alliance's long-term goals were – and still are – to shorten the development cycle reducing time-to-market and cost.

**Reasons for this decision:** As one interviewee stated (P14), the founding members of the GENIVI Alliance were aware that they could work together with an existing OSS foundation. However, they did not want to depend on another organization. As a new non-profit corporation, GENIVI could build everything from scratch, free from the constraints of existing organizational structures or processes. Moreover, since none of the existing foundations had specific knowledge of the automotive sector, this decision was favored by a strong common ground of a number of companies having the required business skills and sharing the same business understanding. Thus, none of the involved parties had to first establish this base together with an existing OSS foundation.

**Analysis of this decision (advantages):** The founders of GENIVI did not want to be controlled by another organization. By building a new non-profit corporation, they were not bound to any higher-level regulations issued elsewhere. The founding members were thus free to decide on the scope, governance structure, technical standards, and processes (individual organizational structures).

GENIVI was not bound to any given process and was able to create everything from scratch. E.g. because contributions come from different employees from various organizations in daily competition, the intellectual property rights management was highly complex. *“One of the significant challenges was the licensing of the open source software, it was done in at least 30 different ways”* (P14). Policies and processes had to be constructed to fit this scenario. In GENIVI, about ten people with different educational backgrounds are involved in license reviewing and, depending on the workload, sometimes even more people are needed. There are two ways to contribute to software: either the source code conforms already to the project's OSS license, or the source code is made public under a different OSS license via the contributor license agreement. As one interviewee stated, *“GPL v3 to this date is still a forbidden license within the automotive community in general”* (P14). Consequently, GENIVI made a clear statement on which licenses are allowed within its projects and which are prohibited (GENIVI, 2014). GENIVI distinguishes between green, orange and red categories of license. Green licenses have been reviewed by GENIVI and are accepted as suitable without restrictions, red licenses have been reviewed and rejected while orange licenses have been



reviewed by GENIVI and are accepted as suitable only under certain conditions. Presently, a GENIVI project can choose among a number of accepted OSS licenses (individual organizational processes).

GENIVI is an alliance in which all members already have a common ground and the required business skills relevant to software development in the automotive sector. Although some of the members involved are in daily competition, they identify themselves strongly with the community as a result of the common business understanding (strong identification with the community).

**Analysis of this decision (disadvantages):** GENIVI first had to build its supporting processes and legal structures before it could focus on software development. In the early stages, the majority of GENIVI's membership fees went to various processes other than actual software development. As one interviewee stated, *"A lot of the members were frustrated because the original charter of the GENIVI alliance was that 70% of the membership-dues that were collected would be contributed to developing software. But in reality, in the early days, it was more like 10%"* (P14). Building a legal structure and processes is time-consuming and resource-intensive (high initial cost).

In order for its projects to work together, GENIVI has to coordinate various processes, such as membership processing, financial management and the provision of an infrastructure for collaboration. Coordinating all these new processes is time consuming and leads to large overheads. Thus, initially at least, more resources had to be spent on organizational overhead of the new organization than on software development (costly overheads).

Building the new legal entity of GENIVI was not only time-consuming and cost intensive, it also carried additional organizational risks. GENIVI first had to create the structures and processes, then to allocate the human resources necessary to provide the services. Furthermore, GENIVI had to establish its own bylaws, which then had to be accepted by the founding members. This took more than a year and involved a number of legal issues, as well as other administrative tasks (organizational risk).

## 4.2 The Case of the Document Foundation and LibreOffice

In 2010, core members of the OpenOffice.org community created a fork of the project because they no longer agreed with the community's governance. As stated by Gamalielsson and Lundell (2014) *"Concerns amongst community members include perceptions on: vendor dominance, copyright assignment, lack of influence, lack of fun, and bureaucracy in the project."* As stated in one interview (P6), community members wanted to create something new, independent from other organizations and stable over time, where a single corporate sponsor did not decide the fate of the community. They wanted to create a stable legal framework that would give its members the right to decide on the future of the community based on meritocracy.

**Decision:** The Document Foundation (TDF) was established in September 2010 as a charitable Foundation under German law<sup>1</sup>. In this kind of legal entity, the will of the founders cannot be altered subsequently and contributors are afforded strong voting rights. The main project of TDF is LibreOffice, an OSS office suite containing programs for word processing, spreadsheets, slideshows, diagrams & drawings. In order to reduce organizational overheads and cost, people from the US who want to contribute to LibreOffice financially can do so via SPI, which handles the general fund-raising process for LibreOffice in North America, or directly to TDF.

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<sup>1</sup> <https://www.documentfoundation.org/governance/board/>

**Reasons for this decision:** The structure of TDF is unique in so far as the will of the founders cannot be altered subsequently. It comprises a board of trustees, a membership committee and a board of directors in which only individuals – not organizations –, may take a seat (Document Foundation, 2012). Although SPI handles the fund-raising process, it does not interfere with the structure or other processes of LibreOffice as other foundations do: *“The projects are independent from SPI, they are not part of SPI, and they are not member projects. So, we call that associated projects because they are independent but we provide some service for them [...] they are not part of SPI and it's different to a lot of other foundations”* (P3).

**Analysis of this decision (advantages):** The legal structure of TDF is unique for an OSS community, guaranteeing its members some unalterable rights, as stated by an interviewee (P5). As an example, TDF is required to notify members publicly of changes in the structure, decisions made, discussions within the board of directors, and conflicts of interests within TDF<sup>2</sup>. TDF has three independent executive bodies: the board of directors, the board of trustees and the membership committee. Membership of the board of trustees is open to everyone who has contributed substantially to the foundation. This body elects the board of directors, as well as the membership committee. Only individuals - not companies, associations or NPOs - are accepted in TDF. While there is an advisory board with companies, associations and NPOs on it, in formal terms this advisory board is not a body of the foundation and has no rights (Document Foundation, 2012). The board of directors prevents conflicts of interests within the foundation and is under an obligation to ensure that not more than one-third of the members of the board of directors, the membership committee and the advisory board are employed by a single company, organization, entity or affiliate (individual organizational structures).

Unlike the OpenOffice.org community, where all contributors have to sign a contributor's agreement, LibreOffice does not have such a requirement. Nevertheless, contributors to LibreOffice have to make a clear license statement such as *“All of my past & future contributions to LibreOffice may be licensed under the MPLv2/LGPLv3+ dual license”*<sup>3</sup>. Compared to other OSS communities, the entry barrier of contributing to LibreOffice is lower. *“We log that and make sure that everyone has a clear e-mail-statement of that form. It's quite easy, there's a very low barrier to entry. Send one e-mail and you're done”* (P4). As another interviewee stated, this simple license statement is helpful in getting more contributions, compared to the situation in other OSS foundations where a developer has to sign a contributor's agreement: *“There you'll get two pages which you have to read and sign and you may not understand them. In this case, you will lose around 50% of the contributions. Then, of course, there are the people who say that they do not fill it out on principle”* (P5), (individual organizational processes).

LibreOffice benefits also from the funding and reimbursement processes, which SPI carries out on their behalf. As stated by an interviewee, SPI provides a lightweight funding and reimbursement process for donations without many restrictions. For LibreOffice, this is ideal because control over what happens with the money remains with them while SPI handles the entire process. SPI accepts donations, holds funds, and keeps the accounts on behalf of LibreOffice. SPI charges 5% of the donations for this service. *“If someone goes to a conference and they want to have their flight or something reimbursed – that's like the bulk of what SPI does and it is not very interesting work processing reimbursements and receipts and stuff”* (P3). However, if LibreOffice were to accept donations e.g. from the United States without the help of SPI, the cost would be higher and specific knowledge would be needed (shared cost).

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<sup>2</sup> <https://www.documentfoundation.org/satzung.pdf>

<sup>3</sup> <https://wiki.documentfoundation.org/Development/Developers>

**Analysis of this decision (disadvantages):** Forking OpenOffice.org and creating LibreOffice was a highly risky endeavor and it was not clear if it would be a runaway success, as one interviewee stated (P4). There was not only the risk of the fork itself, but also that of incorporating the community as a foundation in Germany. As one interviewee explained, obtaining the status of “Stiftung” was hard and the statutes of TDF needed to be altered several times. As P6 explained, the German legal entity called “Stiftung” was new in the context of OSS where different founders build the legal entity. In the end, the status of “Stiftung” was chosen because it guarantees unalterable rights for its members (organizational risk).

Building the new legal entity took several months and involved a large volume of administrative tasks, such as coordination and communication. As an example, EUR 50,000 was needed in order to incorporate as a “Stiftung” in Germany (P6). At that point, it was not clear - even among core members - if the community would be able to collect the money: *“At this point I thought, this was a ridiculous thing to ask people to give money [...]. But people gave it”* (P4), (high initial cost).

Building structures, processes and the IT-infrastructure are some examples of the unavoidable expenses LibreOffice incurred. TDF owns some servers and rents others, spending between EUR 50,000 – EUR 60,000 annually to maintain its IT-infrastructure<sup>4</sup>. TDF employs around 10 people, three of them almost full-time. These three TDF employees work on marketing, administration and release management. Freelancers work on IT-infrastructure management, community management and accounting, but nobody is employed as a software engineer (costly overheads).

## 4.3 The Case of PostgreSQL

PostgreSQL is an object-relational database system developed by a team of mostly volunteer developers at the University of California in Berkeley. In 1996, PostgreSQL was made public as OSS when a group of developers outside the University recognized the potential of the system. While the PostgreSQL community meanwhile encompasses several non-profit corporations, these entities do not own any PostgreSQL code. Therefore, PostgreSQL is not controlled by any company. A committee of five to seven senior contributors sets release dates, handles confidential matters, acts as spokespeople and arbitrates community decisions that are not settled by consensus.

Originally, donors of the PostgreSQL community could donate either to the European (PgEU) or to the US American PostgreSQL NPO (PgUS). Both NPOs used the funds received for their respective area<sup>5</sup>. However, because the PostgreSQL community is not limited to those two regions, they needed a way to generate funds globally.

**Decision:** PostgreSQL decided to use the services of SPI for funding and reimbursement processes without geographical limitation. As an affiliated community of SPI, PostgreSQL is now able to accept donations and raise funds with less restrictions compared to their pre-existing NPOs.

**Reasons for this decision:** As described in an interview (P1), PostgreSQL could have chosen other foundations to handle the funding process. However, other foundations ask for more control and set restrictions in terms of processes and structures. SPI, on the other hand, does not interfere with processes or structures. Moreover, SPI has a fairly low level of bureaucracy.

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<sup>4</sup> <https://wiki.documentfoundation.org/images/f/f2/Accounts-2016-12.ods>

<sup>5</sup> <https://www.postgresql.org/about/donate/>

**Analysis of this decision (advantages):** Although PostgreSQL could have integrated with several other established foundations, the community decided not to join those because they would have been forced to adapt their structure: *“We looked at their governance structure, we looked at our governance structure [...] We couldn't understand how their governance structure would work with our project. Because they usually have very hierarchical structures. And we felt that our project worked really well as it was and we really didn't want to change that”* (P2), (individual organizational structures).

Instead of setting up a new foundation to collect funds without geographical limitation, such services are now obtained from SPI. This means, PostgreSQL is able to use the services of an existing foundation with similar long-term goals. Consequently, cost savings were possible by utilizing synergies as in the case of LibreOffice and to the same price (out-of-the-box principles).

**Analysis of this decision (disadvantages):** Although the PostgreSQL community uses some services of SPI, they still are different legal entities. Originally, the PostgreSQL Foundation Inc. was founded, but failed to be granted non-profit status by the internal revenue service (IRS), and was terminated in 2006. In 2009, the United States PostgreSQL Association succeeded in obtaining exempt status from the IRS. This was not only a risky endeavor, but also an expensive one (high initial cost).

#### 4.4 The Case of PolarSys and the Eclipse Foundation

In 2009, the Open Platform for the Engineering of Embedded Systems (OPEES) was created to support specific issues encountered by industrial users of embedded systems, such as long-term support and maturity assessment for software. Such software often needs to be maintained for a very long time because those systems may be in use for decades (Lundell et al., 2011). Satellites, for example, need support for more than 25 years. A similar case are aircraft flight control systems and the tools used to create software for them. If the vendor of such software leaves the market or decides to support the software no longer, future maintenance of the software becomes uncertain. The OSS development model helps to solve this problem by opening up the source code, thus enabling other companies to provide services. *“With classical proprietary software, there's no company which can maintain it for decades. So that's a very big issue and open source is a way to resolve it”* (P7). By starting an OSS community the people behind PolarSys intended to increase transparency, collaboration and meritocracy in order to form a sustainable ecosystem for support, professional services and other benefits (Blondelle et al., 2013).

**Decision:** Because OPEES members saw OSS as a way to ensure long-term support availability, they decided in 2011 to join forces with the Eclipse Foundation to create the PolarSys Industry Working Group of Eclipse (Blondelle et al., 2013). Core areas of PolarSys are the aerospace industry, defence and security, the energy sector, healthcare, telecommunications and transportation. The goal of PolarSys is to facilitate collaboration between end user companies and to develop an ecosystem around its tools. PolarSys chose to integrate their community with the Eclipse Foundation as their first working group.

**Reasons for this decision:** As Blondelle (2012) describes, PolarSys was created as a working group within the Eclipse Foundation because *“it is easier to claim we build a sustainable entity to ensure long-term availability of software by joining a Foundation that has proven to be sustainable for ten years.”* Sophisticated specifications by PolarSys increase the stability and longevity of the entire Eclipse infrastructure because other working groups inside the Eclipse Foundation deal with the same problem of long-term support for their systems. Finally, OPEES members saw the Eclipse Foundation as a well-respected organization having established processes, which could be used jointly.

**Analysis of this decision (advantages):** PolarSys can host projects on the infrastructure of Eclipse, such as Git repositories, issue tracking systems, mailing lists, and download sites without setting up their own infrastructure or having to maintain it. Thus, PolarSys has outsourced these activities to the Eclipse Foundation. The actual cost of the services provided is modular and depends on the services required by PolarSys. The following statement sums up the key elements of what is referred to as “out-of-the-box-principles”: *“In an own ecosystem you need to create your own processes, your own marketing events; you need to create your own infrastructure, that's very expensive and time consuming because you start from scratch. By being under the umbrella of the Eclipse Foundation, it's less expensive and we can go forward faster”* (P7), (out-of-the-box principles).

As a result, PolarSys can concentrate on what is most interesting for them without having to care for supporting and management processes provided by the Eclipse Foundation. Thus, PolarSys is able to set a clear focus on its core business of software development (focus on core activities).

PolarSys is co-using the existing bylaws of the Eclipse Foundation, which cannot be changed by its working groups. The result is a shorter time-to-market because existing structures and processes can be used as a framework. As P5 explained, if five big companies need to work out their own bylaws, this process can take up to three years, since the lawyers of the five companies must establish and agree on the bylaws (existing bylaws).

PolarSys can also save by utilizing synergies. As stated in one interview, if PolarSys needs more resources, the Eclipse Foundation can employ new people, who may work both for the foundation and for PolarSys. In fact, an additional product manager was hired and the cost of this person is shared between the Eclipse Foundation and PolarSys. If PolarSys needs to have a high volume of code checked to verify that it is IP-clean, they can employ a new person together with the Eclipse Foundation and share the cost. Sharing such cost reduces administrative overheads by buying these common services from the Eclipse Foundation. Moreover, PolarSys benefits both from the experience and the services provided and therefore has more resources available for the software development (shared cost).

The Eclipse Foundation already had a reputation and a thriving community from which PolarSys could benefit. While it takes a substantial effort for a community to establish itself and raise its profile, PolarSys can use the visibility of the Eclipse Foundation as a marketing advantage. PolarSys benefits from organized workshops, conferences, webinars or member meetings organized by the Eclipse Foundation. Such events can be used to enlarge the community and boost interest in PolarSys. As one interviewee stated, this cross-fertilization via the Eclipse Foundation and its working groups can help PolarSys to find new volunteers and market their software (P8). Moreover, the Eclipse Foundation often provides its working groups with exhibition areas and infrastructure at conferences and summits. Such occasions give PolarSys an opportunity to meet developers from the various participating firms (visibility of umbrella organization).

**Analysis of this decision (disadvantages):** PolarSys had to accept the bylaws of the Eclipse Foundation. This is a prerequisite of becoming a working group and can be changed only with a 2/3 majority of the Eclipse board of directors.

PolarSys relies upon the support by the Eclipse Foundation on a legal and marketing level, as well as on a technical level in terms of providing the IT-infrastructure. However, according to one interviewee, since PolarSys is not itself involved directly in the IT-infrastructure, this makes it more difficult to adapt it to its own needs; instead, PolarSys has to deal with the Eclipse Foundation and find a compromise. *“So today we have to follow the IP process and in some projects, they want to take some shortcuts and then the Eclipse Foundation says that they cannot”* (P7).

Applicants for membership of PolarSys have to go through a rather complicated process due to the two-tiered structure of the integrated organization. An applicant may not register for PolarSys

until he has signed up with the Eclipse Foundation. Also, as stated by one interviewee, the division of responsibilities and tasks between PolarSys and the Eclipse Foundation frequently requires consultations with the Eclipse Foundation before carrying out specific actions and processes. On the other hand, the Eclipse Foundation profits from its working groups, illustrated e.g. by the Very Long Term Support (Blondelle et al., 2013) of PolarSys: since one of the main aims of PolarSys is to provide OSS maintenance over several decades, the Eclipse Foundation also benefits from the specifications and infrastructure which PolarSys requires. Moreover, the Eclipse Foundation receives payment from its working groups in return for the provision of “out-of-the-box-principles” (organizational interdependencies).

The Eclipse Foundation requires the licensing of software under the Eclipse Public License (EPL), and PolarSys had to accept this (Eclipse Foundation, 2003). Dual-licensing is permitted only with the approval of the board of the Eclipse Foundation (restricted license-choice).

## 4.5 Aggregation of Findings

In the four cases, we have identified arguments for and against choosing either autonomous or integrated forms of associated collaborations. Figure 2 illustrates these arguments; on the positive side (white background), we have the advantages of the given approach, on the negative side (dark background) are the disadvantages.

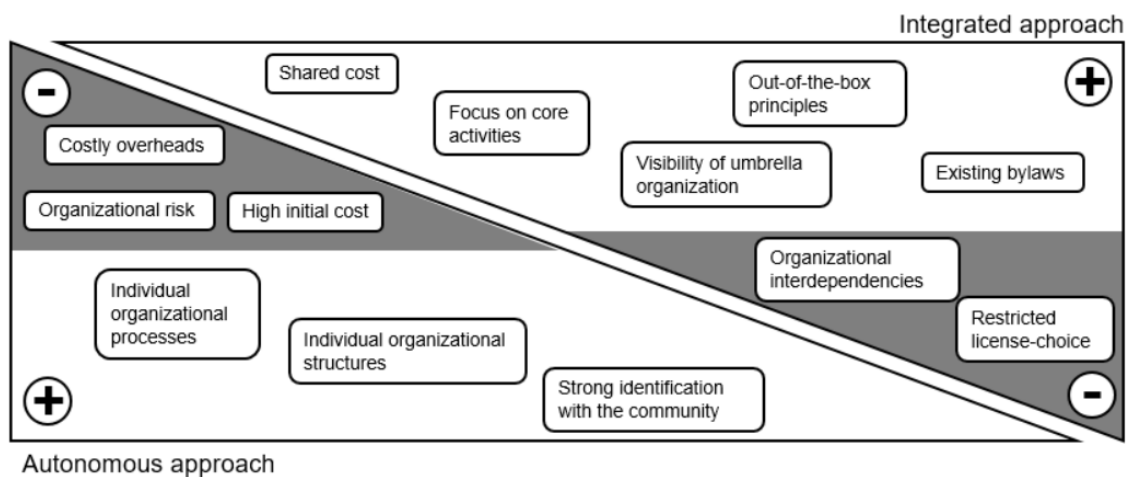


Figure 2: Advantages and disadvantages of inter-organizational affiliation of OSS communities.

Our main findings are summarized in Table 1, providing a brief description of each argument for or against the autonomous or integrated approach.

Category	Argument	Short description
<i>Advantages of the autonomous approach</i>	Individual organizational processes	A community can set up its own processes and is not dependent on any established procedures of another organization.
	Individual organizational structures	A community can build its own organizational structures and does not need to adapt to an existing hierarchy.
	Strong identification with the community	The members identify themselves strongly with the technical and organizational goals of the community.
<i>Disadvantages of the autonomous approach</i>	Organizational risk	In building the new legal entity, the community faces some risks, such as failing to establish bylaws or failing to obtain a desired legal status.
	High initial cost	The community needs to set up a new legal entity, which results in high cost

		when starting its activities.
	Costly overheads	The community has to spend money on administrative work and infrastructure management in order to keep itself running.
<i>Advantages of the integrated approach</i>	Out-of-the-box principles	The community can adopt proven and tested services and structures of other organizations.
	Existing bylaws	A community can co-use existing rules, structures and processes, thus saving time and money.
	Focus on core activities	As a result of using out-of-the-box principles, a community can focus on software development, thus avoiding to spend time and money for activities, which are not at the center of its interest.
	Shared cost	The community can share cost with other communities.
	Visibility of umbrella organization	A community can benefit from the visibility and reputation of an existing foundation, e.g. to get new contributors or to market itself.
<i>Disadvantages of the integrated approach</i>	Organizational interdependencies	A community has to accept certain given structures and processes in order to integrate itself into an existing foundation.
	Restricted license-choice	A community may be restricted in its choice of license as a consequence of integrating itself into an existing foundation.

Table 1: Short description of the arguments for and against the autonomous or integrated approach.

## 5. Conclusions

Starting from our desire to understand why different forms of mature OSS communities exist, we proceed to answer the two research questions at the beginning of this paper carving out the distinct advantages and disadvantages of different forms of inter-organizational affiliations of OSS communities. As our analysis shows, there is no “one size fits all” rule for or against joining an umbrella organization. Different forms of OSS communities exist because there are good reasons for both, the autonomous and the integrated approach of community governance. In addition, the interjacent forms of associated approaches are encountered, leading to even more forms of OSS community governance. Such mixed governance forms intend to profit from the positive aspects of both extreme positions. Our findings indicate that the choice of approach depends on the specific circumstances: Communities choosing the autonomous approach give more weight to arguments for organizational autonomy and individuality whereas the communities preferring the integrated approach of organizational affiliation emphasize the possible cost reduction and efficiency.

Furthermore, we find that all arguments extracted from the interviews and governance documents may be related to the two established management theories we identified by analyzing the research stream of NPO literature. RDT suggests that organizations collaborate to secure critical resources. However, such collaboration is not without cost. The most severe factor is arguably the loss of operating autonomy (Provan, 1984). Therefore, a key challenge for an organization in choosing among different forms of collaboration is keeping the dynamic balance between managing resource dependence and sustaining organizational autonomy (Gray and Wood, 1991). According to RDT, communities taking the autonomous approach favor sustaining organizational autonomy over managing resource dependence (Gray and Wood, 1991). However, as our case studies show, organizational autonomy means high initial as well as recurring cost. Autonomous communities have to build a legal entity on their own, which is cost and time intensive. Moreover, recurring cost cannot be shared with other communities. Therefore, the autonomous approach is usually more costly than the integrated approach.

If the community seeks to reduce their overhead expenses, cooperation with other communities might make sense. TCE suggests that organizations in general cooperate because their partners provide an opportunity to reduce transaction cost (Williamson, 1975). According to TCE, a

given product or service can be obtained either from within an organization or it can be bought from another organization. The decision as to which of the two options is more advantageous depends on the transaction cost associated with each (Williamson, 1975). In the context of OSS communities, common services such as bookkeeping or services related to funding can be obtained from specialized providers, such as OSS foundations. By providing these services to a number of communities and, consequently, achieving cost savings, OSS foundations can offer a market price which may be less than the cost to communities performing the services on their own.

In the associated approach of inter-organizational affiliations, OSS communities hope to achieve cost reductions by buying services from the market. According to TCE, they decide to buy services because the necessary transaction cost of acquiring the services in-house (hierarchy) are higher than the price of an external provider (market). In the case of donation handling, e.g. know-how required to collect and handle the money differs globally and specific knowledge is needed for this task. Specialized market players such as OSS foundations therefore sell such services at a more favorable price lowering transaction cost.

Another way for OSS communities to reduce their cost is the integrated approach of inter-organizational affiliation. In this approach, communities do not just buy services from an existing foundation, they actually become an integrated part of the OSS foundation. Upon integrating, communities benefit from the services and structures provided and can share the cost. However, such forms of collaboration have a price, too. Communities integrating into an existing OSS foundation prefer the ability to secure critical resources over organizational autonomy and therefore not only pay money for the provided services, but also give up some of their organizational autonomy in exchange for interdependencies with the OSS umbrella organization leading to restrictions, as explained in RDT (Provan, 1984). Communities are required to accept certain conditions defined by their umbrella organization and they have to rely on support by the parent entity, e.g. using its IT infrastructure, applying its bylaws or integrating predefined processes.

## **6. Discussion**

In this final section, we elaborate on the implications of our findings, their limitations and possible future research in the area of OSS community governance.

### **6.1 Implications for Practitioners and Researchers**

The results of this study provide useful information for practitioners. First, the results of our study can provide guidance for OSS community leaders regarding the choice of how to govern the project. They can obtain an overview of potential advantages and disadvantages of collaborating with existing OSS foundations as compared to setting up their own foundation and, on this basis, decide which of the different approaches meets their needs best. E.g. they can use our results as a list of arguments to decide whether to be autonomous, integrated or to use an interjacent strategy.

Second, existing OSS foundations can try to focus on reducing their disadvantages in order to attract additional OSS communities. We believe our results encourage existing foundations to see the advantages and disadvantages of their business model from a more systematic point of view. Moreover, our results might help umbrella organizations to empathize better with their members who pay for the services provided not only in terms of money but also in terms of a loss of autonomy.

Third, as our case studies on GENIVI and PolarSys showed, companies from certain sectors collaborate increasingly on software platforms by applying the OSS development model. Such



industry-specific OSS communities have been called “super-communities” by the initiators of PolarSys pointing out the strengths of focusing on professional services and other industry-related benefits (Blondelle et al., 2013). Those communities in particular have to decide whether they want to be governed autonomously like the GENIVI community, or if they should better integrate with an existing umbrella organization like PolarSys joining the Eclipse Foundation. Our results provide guidance on this strategically relevant decision.

With respect to researchers, the present study has two main theoretical implications: First, we have analyzed the situation of OSS communities intending to improve their governance. Unlike previous studies (e.g. Riehle and Berschneider 2012) our unit of analysis was not the foundation but the OSS community. Therefore, our results are new to OSS research shedding light on issues of OSS governance. This is especially important to better understand different forms of governance on a macro-level.

Second, we have analyzed the decisions of OSS communities and their arguments for them through the lenses of RDT and TCE. Thus, we are able to explain the underlying motivation from the perspective of established economic management theories. Each of the advantages and disadvantages identified by our qualitative empirical analysis relates to core elements of RDT or TCE. Therefore, we conclude that those two organizational theories are suitable for explaining the different organizational decisions.

## 6.2 Limitations

Our research has a number of limitations which may affect the validity of our results. First, construct validity reflects the extent to which the studied operational measures reflect what the researcher intended to study according to the research goals. Research question 1 assumes OSS communities can choose among three different options in order to govern their community. However, the analyzed communities represent only a small subset of possible case studies and therefore do not necessarily show all possible approaches on how collaboration with OSS foundations could be achieved.

Second, internal validity is relevant if causal relations are examined. We do not argue for causal relations but for circumstantial factors, which may play a role when choosing between different forms of collaboration. Although we have used two different sources of data (interviews and publicly accessible documents) over a prolonged period of time, the internal validity of our results could be improved in future research. In particular, sampling within a community should be carefully considered in order to take into account the different perspectives of the various roles of an OSS community.

Third, external validity is concerned with the extent to which findings can be generalized. Our study analyzed four OSS communities fairly large in terms of contributors while many other OSS communities are much smaller. Moreover, the analyzed communities are only a little subset of possible case studies and therefore do not necessarily show all possible approaches to collaboration with OSS foundations. Therefore, our study does not aim for completeness but for theory construction.

Fourth, reliability is affected by the extent to which the data and the analysis are dependent on a specific researcher. In order to enhance reliability, the data analysis has been discussed by two persons. Although we felt saturation was reached after analyzing 4 communities and conducting 16 interviews, other researchers could possibly reveal further findings by analyzing more communities.

## 6.3 Future Research and Outlook

As the implications and limitations indicate, there is potential for future research in the area of inter-organizational affiliations of OSS communities. On one hand, our findings could be tested in a quantitative research design e.g. by means of a survey of leaders of OSS communities verifying the arguments regarding inter-organizational affiliation. In such a survey, questions could be asked regarding the effects of legal structures on the success of OSS communities: How is efficiency and durability of OSS communities influenced by their inter-organizational affiliation? How does joining an umbrella organization affect the motivation of individual developers? From what services of umbrella or associated organizations does the OSS community benefit most?

On the other hand, additional in-depth qualitative research could reveal the relationship between characteristics of OSS software products (development process models, etc.) and the different forms of OSS community governance. This would allow analyzing the impact of decision-making in OSS development towards the choice of inter-organizational affiliation and vice-versa, how the different forms of OSS community governance influence decision-making processes in OSS development.

Finally, it would be interesting to better understand the interjacent strategy intending to obtain the advantages of both, the autonomous and the integrated approach. If it is indeed possible to benefit from synergies of simultaneously managing several OSS communities while maintaining legal independence, then why would not more OSS communities choose such a support organization? Interestingly, there is one exceptionally successful umbrella organization following this interjacent strategy, the Linux Foundation. As of June 2018, it has already more than 1000 corporate members<sup>6</sup> and provides hosting for more than 100 OSS communities<sup>7</sup>. Frequently new corporations and OSS communities working on leading edge technology such as artificial intelligence and Blockchain join the Linux Foundation (The Linux Foundation, 2018) increasing its influence and power. It is therefore of great interest for future research to investigate how this particular umbrella organization starting from one single OSS project, the Linux Kernel, has achieved becoming the home of many dozens of highly visible OSS communities such as Node.js, Hyperledger, Xen or the R Consortium.

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<sup>6</sup> <https://www.linuxfoundation.org/membership/members/>

<sup>7</sup> <https://www.linuxfoundation.org/projects/>

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## Appendix 1

#	Name, function, association	Type	Date	Focus of questions
P1	Joshua Drake, PostgreSQL Funds Liaison	Written Interview	2017-02-15	Organizational structure, association with SPI
P2	Bruce Momjian, Core Team member PostgreSQL	Skype call	2017-03-13	Organizational structure, reasons to integrate, software development process
P3	Martin Michlmayr, President of Software in the Public Interest	Skype call	2017-03-10	Organizational structure, reasons for founding, autonomous vs. integrated OSS organizations
P4	Michael Meeks, Deputy Chairman of the Board, TDF	Google Hangouts call	2016-12-13	Organizational structure, reasons for founding, autonomous vs. integrated OSS organizations, software development process
P5	Thorsten Behrens, Board of Directors, TDF	Skype call	2016-12-16	Organizational structure, reasons for founding, autonomous vs. integrated OSS organizations
P6	Florian Effenberger, Executive Director of TDF	Phone call	2016-12-22	Organizational structure, reasons for founding, autonomous vs. integrated OSS organizations, funding process, organizational structure
P7	Etienne Juliot, elected participating member representative, PolarSys	In person	2015-11-03	Founding reasons, reasons to integrate, advantages and disadvantages of PolarSys being in the Eclipse Foundation, contributors
P8	Ralph Mueller, Managing Director Europe, Eclipse Foundation	Phone call	2014-11-20	Organizational structure, reasons for founding, autonomous vs. integrated OSS organizations, future of OSS community
P8	Ralph Mueller, Managing Director Europe, Eclipse Foundation	Skype call	2016-05-04	Organizational structure, reasons for founding, autonomous vs. integrated OSS organizations
P9	Gaël Blondelle, Director of European Ecosystem Development, Eclipse Foundation and PolarSys expert	In person	2015-11-02	Founding reasons of PolarSys, organizational structure, long-term-support, difficulties
P10	Dominique Toupin, representing Ericsson and chairman of the GENIVI Alliance	In person	2015-11-03	Long-Term-Support, dependencies on the Eclipse Foundation, advantages and disadvantages of being in the Eclipse Foundation, crucial points in the beginning
P11	Claus-Peter Wiedemann, Lead License Review Team, GENIVI Alliance	Phone call	2014-11-21	Tasks, license review team, coopetition, competition with similar organizations, future of OSS community
P12	Jeremiah Foster, Community manager, GENIVI Alliance	Skype call	2014-11-11	User-driven vs. developer-driven OSS communities, free-riding, content of contributed software, future of OSS community
P12	Jeremiah Foster, Community manager, GENIVI Alliance	Google Hangouts call	2015-11-17	Code quality of GENIVI, contributors, founding and financial situation, coopetition, comparisons to Linux Foundation
P13	Steve Crumb, Executive Director, GENIVI Alliance	Skype call	2014-10-23	Organizational structure, reasons for founding, coopetition, funding, free-riding, expected influence on automotive industry
P14	Joel Hoffmann, Director of Marketing and Board Director of GENIVI	Skype call	2015-12-01	Founding GENIVI community, automotive industry, reasons and goals of the alliance, comparisons to Linux Foundation

Appendix 1: Conducted interviews.

## Appendix 2

Association	Document type	Title	Reason for inclusion	Pages	Date	Available on
GENIVI	Legal	Bylaws	Governance Description	37	10/2011	<a href="http://www.genivi.org">www.genivi.org</a>
GENIVI	Legal	Intellectual Property Rights Policy	Legal Description	13	02/2012	<a href="http://www.genivi.org">www.genivi.org</a>
GENIVI	Legal	Participation Agreement	Governance Description	2	01/2012	<a href="http://www.genivi.org">www.genivi.org</a>
GENIVI	Legal	Public Policy for GENIVI Licensing and Copyright Version 2.0	Legal Description	15	n.a.	<a href="http://www.genivi.org">www.genivi.org</a>

GENIVI	Organizational	1. Functional Organization Chart 2. Instructions for Obtaining Membership 3. Membership Value 4. Compliance Programs	Governance Description	n.a.	09/2012	<a href="http://www.genivi.org">www.genivi.org</a> <a href="http://www.genivi.org">www.genivi.org</a> <a href="http://www.genivi.org">www.genivi.org</a> <a href="http://www.genivi.org">www.genivi.org</a>
Eclipse	Legal	Eclipse Bylaws	Governance Description	23	08/2011	<a href="http://www.eclipse.org">www.eclipse.org</a>
Eclipse	Legal	Eclipse Intellectual Property Rights	Legal Description	11	07/2011	<a href="http://www.eclipse.org">www.eclipse.org</a>
Eclipse	Legal	Eclipse Membership Agreement	Governance Description	11	04/2008	<a href="http://www.eclipse.org">www.eclipse.org</a>
Eclipse	Legal	Eclipse Public License V 1.0	Legal Description	4	04/2009	<a href="http://www.eclipse.org">www.eclipse.org</a>
Eclipse	Legal	PolarSys Industry working group Participation Agreement	Legal Description	8	02/2012	<a href="http://www.eclipse.org">www.eclipse.org</a>
Eclipse	Organizational	Eclipse Types of Membership	Governance Description	n.a.	n.a.	<a href="http://www.eclipse.org">www.eclipse.org</a>
Eclipse	Organizational	Eclipse Membership Rights	Governance Description	n.a.	n.a.	<a href="http://www.eclipse.org">www.eclipse.org</a>
Eclipse	Organizational	PolarSys working group Charter	Governance Description	n.a.	12/2015	<a href="http://www.eclipse.org">www.eclipse.org</a>
Eclipse	Organizational	PolarSys Members	Governance Description	n.a.	n.a.	<a href="http://www.polarsys.org">www.polarsys.org</a>
Eclipse	Organizational	PolarSys/TLP Proposal	Governance Description	n.a.	09/2012	<a href="http://www.eclipse.org">www.eclipse.org</a>
Eclipse	Organizational	2014 Annual Eclipse Community Report	Financial Overview	n.a.	06/2014	<a href="http://www.eclipse.org">www.eclipse.org</a>
TDF	Organizational	Statutes of TDF	Legal Description	n.a.	02/2012	<a href="http://www.documentfoundation.org">www.documentfoundation.org</a>
TDF	Organizational	Annual Reports TDF 2012-2016	Financial Overview	n.a.	n.a.	<a href="http://www.documentfoundation.org">www.documentfoundation.org</a>
TDF	Organizational	Details of the Annual Report of the Document Foundation, 2015-2017	Financial Overview	n.a.	n.a.	<a href="http://www.documentfoundation.org">www.documentfoundation.org</a>
TDF	Legal	Policies & Trademark Policy of TDF	Legal Description	n.a.	12/2015	<a href="http://www.documentfoundation.org">www.documentfoundation.org</a>
TDF	Legal	Licenses in TDF	Legal Description	n.a.	n.a.	<a href="http://www.libreoffice.org">www.libreoffice.org</a>
PostgreSQL	Organizational	IRS exempt status	Legal Description	2	04/2009	<a href="http://www.postgresql.us">www.postgresql.us</a>
PostgreSQL	Organizational	Project and Release Management	Governance Description	43	05/2008	<a href="http://www.pgcon.org">www.pgcon.org</a>
SPI	Organizational	Annual reports 2003-2016	Financial Overview	n.a.	n.a.	<a href="http://www.spi-inc.org">www.spi-inc.org</a>
SPI	Legal	Bylaws	Governance Description	n.a.	08/2016	<a href="http://www.spi-inc.org">www.spi-inc.org</a>
SPI	Organizational	Services	Governance Description	n.a.	n.a.	<a href="http://www.spi-inc.org">www.spi-inc.org</a>
SPI	Organizational	Associated Projects how to	Governance Description	n.a.	n.a.	<a href="http://www.spi-inc.org">www.spi-inc.org</a>

Appendix 2: Analyzed documents from GENIVI, Eclipse/PolarSys, TDF, PostgreSQL and SPI.

## Appendix 3

Question from the interview questionnaire	Reason for question
Were there any alternatives than founding your own legal entity?	Focus on different forms of community governance according to our first research question.

What were the reasons to found your own organization?	Focus on the advantages of the autonomous approach.
What were the crucial points to join XYZ?	Focus on the advantages of the integrated or associated approach.
How do you profit from reusing resources from XYZ?	Focus on the advantages of the integrated or associated approach.
What were your experiences providing these services on your own?	Focus on the disadvantages of the autonomous approach.
What are the dependencies between your community and XYZ?	Focus on the disadvantages of the integrated or associated approach.
How did it come that you work together with XYZ?	Focus on the history of the collaboration of the community and the umbrella organization.

Appendix 3: Excerpt of the interview questionnaire.